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GROWING RUSSIAN WILD RYEGRASS

IN WESTERN CANADA



Agriculture
Canada

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CONVERSION FACTORS FOR METRIC SYSTEM		
Imperial units	Approximate conversion factor	Results in:
LINEAR		
inch	x 25	millimetre (mm)
foot	x 30	centimetre (cm)
yard	x 0.9	metre (m)
mile	x 1.6	kilometre (km)
AREA		
square inch	x 6.5	square centimetre (cm ²)
square foot	x 0.09	square metre (m ²)
acre	x 0.40	hectare (ha)
VOLUME		
cubic inch	x 16	cubic centimetre (cm ³)
cubic foot	x 28	cubic decimetre (dm ³)
cubic yard	x 0.8	cubic metre (m ³)
fluid ounce	x 28	millilitre (ml)
pint	x 0.57	litre (l)
quart	x 1.1	litre (l)
gallon	x 4.5	litre (l)
bushel	x 0.36	hectolitre (hl)
WEIGHT		
ounce	x 28	gram (g)
pound	x 0.45	kilogram (kg)
short ton (2000 lb)	x 0.9	tonne (t)
TEMPERATURE		
degrees Fahrenheit	(°F-32) x 0.56 or (°F-32) x 5/9	degrees Celsius (°C)
PRESSURE		
pounds per square inch	x 6.9	kilopascal (kPa)
POWER		
horsepower	x 746	watt (W)
	x 0.75	kilowatt (kW)
SPEED		
feet per second	x 0.30	metres per second (m/s)
miles per hour	x 1.6	kilometres per hour (km/h)
AGRICULTURE		
gallons per acre	x 11.23	litres per hectare (l/ha)
quarts per acre	x 2.8	litres per hectare (l/ha)
pints per acre	x 1.4	litres per hectare (l/ha)
fluid ounces per acre	x 70	millilitres per hectare (ml/ha)
tons per acre	x 2.24	tonnes per hectare (t/ha)
pounds per acre	x 1.12	kilograms per hectare (kg/ha)
ounces per acre	x 70	grams per hectare (g/ha)
plants per acre	x 2.47	plants per hectare (plants/ha)

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A PASTURE GRASS FOR DRY AREAS

Russian wild ryegrass is especially useful for pasture in the dry prairies. This grass is a long-lived perennial bunchgrass with extensive fibrous roots. It is exceptionally tolerant of cold and drought. Russian wild ryegrass cures well in the field and retains most of its nutritive value throughout the summer and late fall. Livestock pastured on this grass make good gains, even in the fall when they tend to lose weight on most other grasses. Russian wild ryegrass is one of the best grasses for farmyards and lawns that are not watered.

If you are going to use Russian wild ryegrass, remember:

- Mayak, Sawki, and Cabree are the recommended cultivars.
- For pasture, seed in the spring in a well-prepared seedbed, or in the late fall into stubble that has been sprayed with a herbicide for control of winter annuals. Seed at 3.4 to 5.6 kg/ha (3 to 5 lb/ac) and 1.3 to 2.5 cm ($\frac{1}{2}$ to 1 in.) deep. In dry areas, space the rows 45.7 to 91.4 cm (18 to 36 in.) apart; in moist areas, 30.5 to 45.7 cm (12 to 18 in.) apart.
- Seed a legume with Russian wild ryegrass wherever possible. Drylander and Rambler alfalfa are recommended.
- When grown for seed, Russian wild ryegrass makes an ideal dual-purpose crop as the aftermath provides a nutritious, palatable pasture for late summer and fall. For a seed crop, drill in rows 91.4 cm (36 in.) apart at 2.2 to 3.4 kg/ha (2 to 3 lb/ac).
- Seed yields may be maintained at a high level for several years by fertilizing, removing the aftermath, and irrigating.
- Harvest for seed when the straw is golden yellow and the seed is in the late-milk to firm-dough stage. Swathing and combining is the recommended harvest procedure.
- For farmyards and lawns, broadcast or drill the seed at a heavy rate on a well-prepared seedbed.



GROWING RUSSIAN WILD RYEGRASS IN WESTERN CANADA

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Russian wild ryegrass, *Elymus junceus* Fisch., was introduced from Siberia by the University of Saskatchewan in 1926. It was first grown at the Research Station, Swift Current, in 1936, and was distributed from there to seed growers in Western Canada in 1949. It is an excellent pasture grass for the southern areas of the Canadian prairies. Besides providing early spring and summer pasture, it has good curing qualities that make it especially useful for late summer and fall grazing. The aftermath from seed production fields is nutritious and can be used for late summer and fall pasture.

Russian wild ryegrass is a long-lived perennial bunchgrass with extensive fibrous roots. It is very tolerant of cold and drought. Seedlings grow more slowly than those of crested wheatgrass and consequently it is more difficult to establish. Once established, however, it is more persistent than crested wheatgrass (Fig. 1). The leaves of Russian wild ryegrass are mostly basal; a few develop on the seedstalks. Seedstalks seldom form when the grass is grown in solid seedings, but when it is grown in spaced rows they are 60 to 120 cm (24 to 48 in.) tall.

The head is a dense spike with seeds that shatter readily at maturity. The seed is similar in size and shape to that of Summit or Nordan crested wheatgrass.



Fig. 1. Russian wild ryegrass plants (left) in a nursery were still intact 14 years after planting. Crested wheatgrass plants (right), were dying from the centers of the clumps (arrows).

ADAPTATION

Russian wild ryegrass grows wild in the steppe and steppe slope areas of Siberia and central Asia.

In Canada, Russian wild ryegrass is well adapted to the loam and clay soils of the prairies of Saskatchewan, Alberta, Manitoba, the semiarid interior of British Columbia, and the Peace River and Fort Vermilion region. It is more difficult to establish on sandy soils in dry areas than crested wheatgrass because the seedlings grow slowly and may not get rooted deeply enough before the surface soil dries out. Once established, however, it does well on sandy soil. Also, this grass tolerates saline soil rather well.

CULTIVARS

Mayak, Sawki, and Cabree are the recommended cultivars in Canada. Both Mayak and Sawki were developed at the Research Station, Swift Current, Sask., whereas Cabree was developed at the Research Station, Lethbridge, Alta. Mayak yields 16% more seed and 6% more forage than Sawki. It is also more resistant to leaf spotting. Cabree is more resistant to seed shattering than the other cultivars, but yields less seed and slightly more forage.

Vinall, developed at Mandan, N. Dak., by the United States Department of Agriculture, is recommended in the United States. In Canada it is inferior to Sawki.

USES AND MANAGEMENT

Pasture

Russian wild ryegrass is valuable for pasture when grown alone or in association with alfalfa. It recovers rapidly after grazing when moisture is adequate (Fig. 2) and has a long period of growth starting in early spring and continuing to late fall (Fig. 3).



Fig. 2. Russian wild ryegrass (foreground) resumes growth much better after cutting than crested wheatgrass (background). The photo was taken 1 week after cutting in June.

This grass remains palatable and maintains a high nutritive value throughout the summer and fall, and even into early winter. These good curing qualities are reflected in the chemical composition of the forage at various stages of development (Table 1) and in relatively high liveweight gains obtained in the fall (Fig. 4).

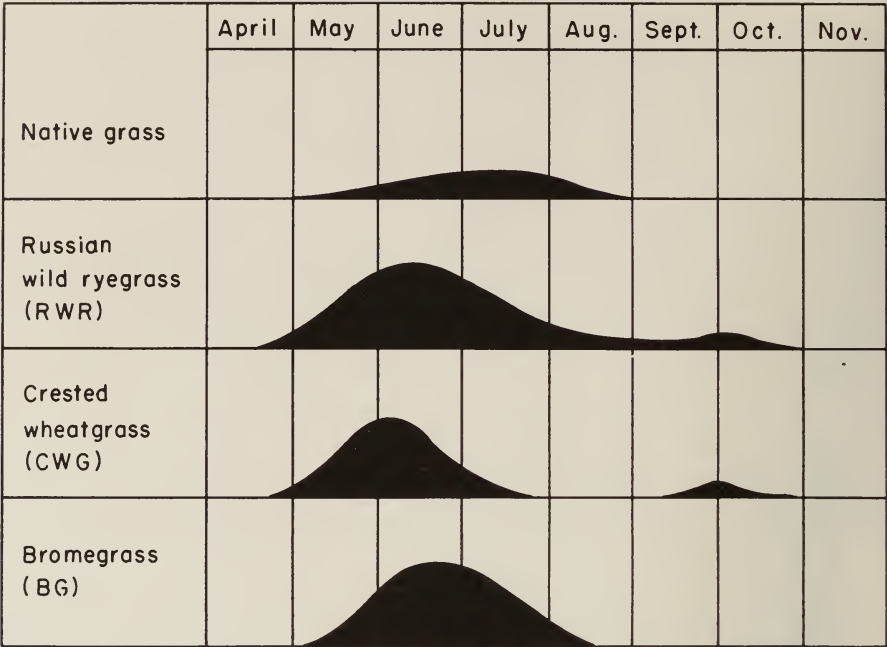


Fig. 3. Relative yield and period of growth of native grass and seeded pastures.

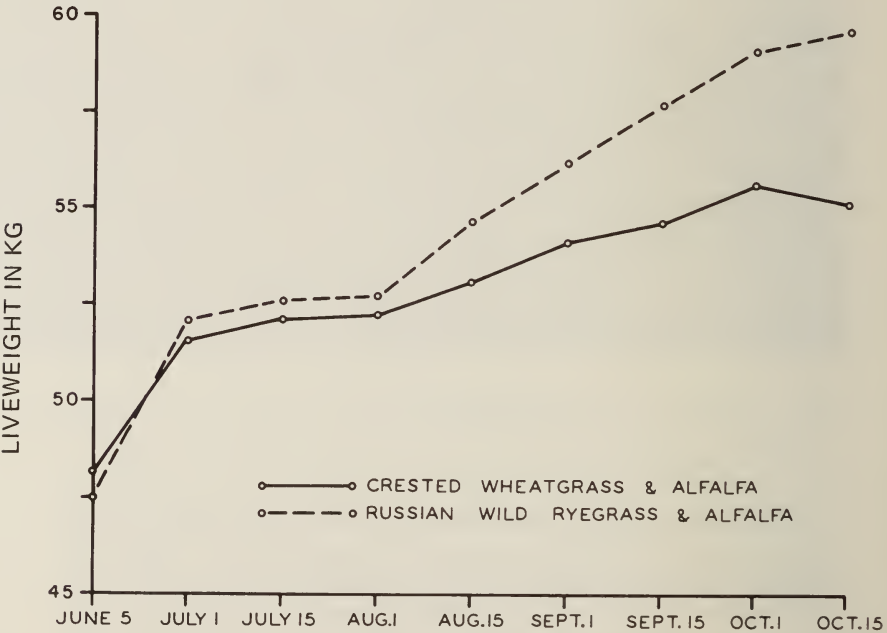


Fig. 4. Four-year average weight of 70 yearling ewes while grazing on Russian wild ryegrass - alfalfa and crested wheatgrass - alfalfa pastures from date following shearing to end of grazing season (kg \times 2.205 = lb).

TABLE 1. Chemical compositions of three pasture grasses at progressive stages of development (average percentages of various constituents in a 2-year test).

Constituents	Grass	Early leaf	Shot- blade	Flower	Mature seed	Late fall	Next spring
Crude protein	Russian wild ryegrass	21.1	16.4	11.5	9.4	7.3	7.1
	Crested wheatgrass	20.1	14.2	6.4	5.4	3.1	3.4
	Bromegrass	20.7	17.1	10.4	7.3	4.5	4.6
Carbohydrates	Russian wild ryegrass	42.9	46.6	46.3	44.9	45.7	44.3
	Crested wheatgrass	44.7	49.8	55.0	55.7	49.7	47.9
	Bromegrass	43.9	46.5	53.1	54.3	49.9	48.3
Fat	Russian wild ryegrass	1.7	1.6	1.4	1.7	1.6	1.2
	Crested wheatgrass	2.2	1.7	1.4	1.7	1.1	0.7
	Bromegrass	2.3	2.0	1.5	1.8	1.4	1.0
Ash	Russian wild ryegrass	10.2	8.9	8.0	9.2	7.5	8.6
	Crested wheatgrass	9.0	7.8	6.0	6.7	7.3	7.8
	Bromegrass	10.6	10.0	6.8	8.0	7.8	9.3
Crude fiber	Russian wild ryegrass	24.0	26.5	32.8	34.7	37.9	38.8
	Crested wheatgrass	24.0	26.4	31.1	30.6	38.8	40.3
	Bromegrass	22.4	24.4	28.2	28.5	36.4	37.0

The practice of breaking native prairie and reseeding it to Russian wild ryegrass and alfalfa offers excellent possibilities for increasing pasture production, by 3 to 6 times (Table 2), as well as lengthening the pasture season (Fig. 5).

TABLE 2. Comparative liveweight gains during full season grazing on native and on Russian wild ryegrass pastures at Manyberries, Alta.

Pasture	Liveweight gains			
	Sheep (7-month season) 10-yr mean		Steers (6-month season) 6-yr mean	
	kg/ha (lb/ac)	% of native	kg/ha (lb/ac)	% of native
Native range	9.3 (8.3)	100	17.9 (16.0)	100
Russian wild ryegrass	29.5 (26.3)	317	107.8 (96.2)	601

Recommended seasons of use of pasture crops									Hectares per cow			Comments
May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		Sail Zone	Dark Brown	Block-Gray	
		Native Grass							12-14	6-8	5-6 (Excluding bush)	Grazing native grass before mid-June is not recommended because early season grazing sharply reduces its carrying capacity.
		RWR plus Alfalfa							2-4	1.8-3	1.2-2.5	Seed two or more fields to provide earliness and continuity of grazing throughout the season.
		RWR plus Alfalfa							0.8-1.2	0.6-1.0	0.4-0.8	Choose grasses to meet your grazing needs. Seed two or more fields to provide earliness and continuity of grazing.
		RWR or CWG plus Alfalfa							0.8-1.2	0.6-1.0	0.4-0.8	
			RWR plus Alfalfa or Seed field residue						0.8-1.2	0.6-1.0	0.4-0.8	
		RWR plus Alfalfa							0.8-1.2	0.6-1.0	0.4-0.8	Russian wild ryegrass can be used to lengthen the grazing season provided by other pastures and cereal stubble.
		RWR or CWG plus Alfalfa							0.8-1.2	0.6-1.0	0.4-0.8	
				Cereal Stubble								
								RWR plus Alfalfa or Seed field aftermath	0.4-0.8	0.3-0.5	0.2-0.4	Russian wild ryegrass provides early pasture and usually some fall grazing. By delaying grazing of the native grass it will be more productive.
		RWR plus Alfalfa							0.8-1.2	0.6-1.0	0.4-0.8	
		Native Grass							6-7	3.6-5.0	2.5-3.6	
		RWR plus Alfalfa							0.8-1.2	0.6-1.0	0.4-0.8	Unused summer growth of Russian wild ryegrass will provide palatable and nutritious late fall grazing. Graze RWR in the spring to restrict seed stalk formation.
		Native Grass							4.5-6.5	2.8-3.6	2-3	
								RWR plus Alfalfa or Seed field aftermath	0.8-1.2	0.6-1.0	0.4-0.8	

Fig. 5. Pasture systems with Russian wild ryegrass (RWR) provide more pasture for more months (hectares \times 2.471 = acres).

Seed culm formation on Russian wild ryegrass pastures can be restricted by stocking so that the forage is grazed off to a height of 5 to 7 cm (2 to 3 in.) by about June 1. Subsequent regrowth will not contain seed stems and could provide a second grazing period in the fall.

Seeding and land preparation. Early spring and late fall have been the most successful seeding times for establishing Russian wild ryegrass. For spring seeding, firm the seedbed to ensure shallow seeding. Depth controls attached to the drill discs help to seed at a uniformly shallow depth of less than 2.5 cm (1 in.) (Fig. 6). Because Russian wild ryegrass seedlings develop slowly, destroy weeds before seeding either by

cultivation or with herbicides. Weeds compete with the grass seedlings for moisture and light. You may use chemical weed control again after the grass has developed beyond the three-leaf stage. Because alfalfa is sensitive to certain herbicides, care must be exercised when spraying stands that include it. Check with your local extension specialist for the latest herbicide recommendations.

Fall seeding should be done after mid-October, into weed-free stubble. The stubble field should be sprayed with a herbi-

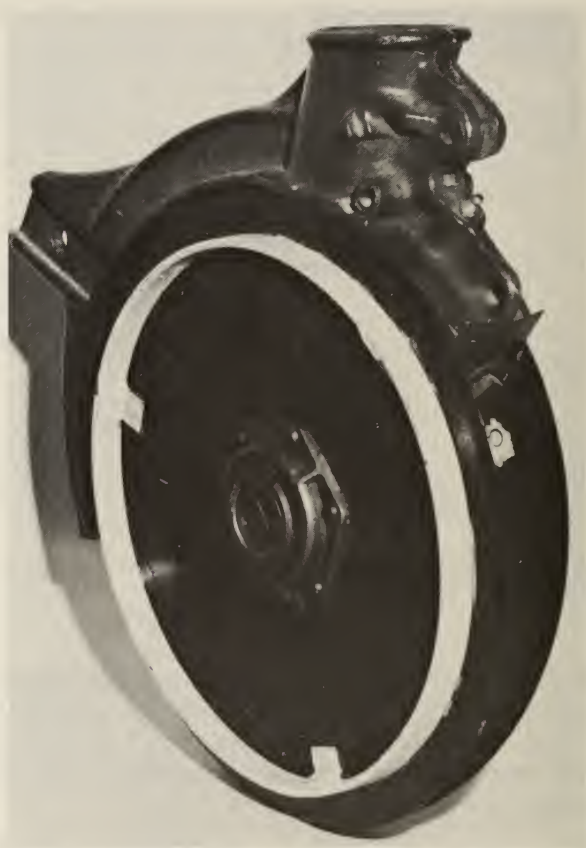


Fig. 6. Flange rings spot-welded to drill discs to control depth of seeding.

cide either just before or soon after seeding to control winter annual weeds such as flixweed, stinkweed, or narrow-leaved

hawk's-beard. These weeds reduce stands of fall-seeded forage crops through competition the next spring (Fig. 7). Spraying rather than cultivating leaves a firm seedbed, and the stubble traps snow to ensure a better moisture supply for early spring germination.



Fig. 7. Control of winter annuals by fall spraying of stubble fields. Photo taken in spring. Plots not sprayed in the previous fall (left), and sprayed with 2,4-D ester at 420 ml/ha (6 oz/ac) in the previous fall (right).

Row spacing, seeding pattern, and fertilizer use. Moisture is the principal factor that limits forage production in most of the area to which Russian wild ryegrass is adapted. These limiting effects of low precipitation and high evaporation can be reduced somewhat by adjusting the plant population to suit the available moisture. This is most easily achieved by varying the space between the rows (Table 3). Row spacings of 60 to 90 cm (24 to 36 in.) are recommended for the dry southern prairies and spacings of 30 to 45 cm (12 to 18 in.) are recommended for the northern prairies.

Many studies have shown the advantage of including alfalfa with grasses for pasture seedings (Fig. 8). Other studies

TABLE 3. Productivity of Russian wild ryegrass as influenced by row spacing.

Row spacing cm (in.)	Swift Current				Mandan, N. Dak.
	Yield test 15-yr mean	Fall grazing study 9-yr mean		Full season grazing	
		Stocked at 1 animal unit/0.6 ha			
	Dry matter yield kg/ha (lb/ac)	Dry matter yield kg/ha (lb/ac)	Days of grazing	7-yr mean weight gains kg/ha (lb/ac)	
15 (6)	—	—	—	179 (160)	
20 (8)	—	870 (776)	25	—	
30 (12)	821 (732)	—	—	—	
40 (16)	—	1008 (899)	31	—	
60 (24)	1303 (1162)	1449 (1293)	37	—	
90 (36)	1182 (1054)	—	—	237 (211)	
120 (48)	1132 (1010)	—	—	—	

have shown the advantage of growing grass and alfalfa in alternate rows or in cross-seeded rows rather than as mixtures in the same row (Fig. 9). The choice of an alternate-row or cross-seeded pattern results in better production than use of a mixed grass-alfalfa stand (Table 4).

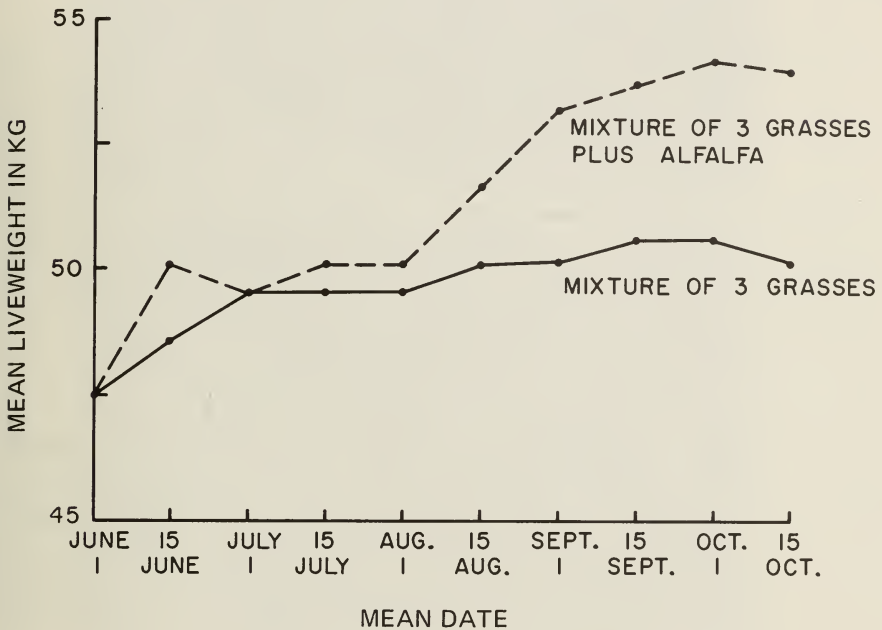


Fig. 8. Six-year average weight of yearling ewes following shearing to end of grazing season ($\text{kg} \times 2.205 = \text{lb}$).

Observations indicate that Russian wild ryegrass is very competitive with alfalfa when they are seeded in mixture, and alfalfa will persist longer in a stand if alternate rows or cross-seeding is used. The cross-seeded pattern has additional advantages. Small pockets are formed to reduce runoff and water erosion. Also, the grass can be seeded at its correct seeding rate in one direction and the alfalfa can then be planted at its correct seeding rate in a second seeding, either diagonally, across, or at right angles to the rows of grass.

Fertilizer is not required in the Brown and Dark Brown soil zones when a legume is included in the pasture. When grass is grown alone, rely on soil tests to determine the fertilizer requirements.



Fig. 9. Example of stand patterns: (from top to bottom) mixture, alternate rows, and crossed rows.

TABLE 4. Comparative yield of grass and alfalfa as influenced by pattern of seeding.

	5-yr mean dry matter yield as % of 30 cm (12 in.) mixed stand
30-cm (12-in.) mixed rows	100
60-cm (24-in.) mixed rows	121
90-cm (36-in.) mixed rows	129
30-cm (12-in.) crossed rows	119
60-cm (24-in.) crossed rows	136
90-cm (36-in.) crossed rows	125
30-cm (12-in.) alternate rows	126
60-cm (24-in.) alternate rows	134
90-cm (36-in.) alternate rows	103

Hay

Russian wild ryegrass is not recommended for hay. It generally yields less than either crested wheatgrass or brome grass when grown alone or with alfalfa. A number of tests have shown the average hay yields for Russian wild ryegrass, crested wheatgrass, and brome grass grown alone and with alfalfa, on a range of soil types, and over several years (Table 5).

TABLE 5. Average yields of various grasses grown alone or with alfalfa.

Grass	Dry matter yield in kg/ha (lb/ac)	
	Alone	With alfalfa
Russian wild ryegrass	1278 (1140)	2152 (1920)
Crested wheatgrass	1547 (1380)	2376 (2120)
Brome grass	1457 (1300)	2242 (2000)

Farmyards and lawns

Russian wild ryegrass is one of the best grasses for farmyards and lawns that cannot be watered (Fig. 10). It is leafy,

seldom forms stems, and remains green for most of the summer. It recovers more quickly after cutting than crested wheatgrass and does not invade trees and hedges as crested wheatgrass does. The sod formed by Russian wild ryegrass is extremely tough and stands considerable abuse from trampling and driving. In tests at Saskatoon and Indian Head, Sask., it has been more durable than crested wheatgrass.



Fig. 10. A modern farmyard and lawn sown with Russian wild ryegrass.

For lawns and small yards, broadcast Russian wild ryegrass by hand or with a small cyclone seeder at 1.5 to 2.0 kg of seed on each 100 m² (3 to 4 lb of seed on 1000 sq ft). Prepare the seed-bed and rake or harrow it before and after seeding to firm the soil and cover the seed.

For large areas use a drill. Set the drill to seed at about 17 kg/ha (15 lb/ac or the drill setting for 1 bushel of wheat) and cover the area in at least two directions at right angles to one another.

Be sure to protect the newly sown area during the first season of growth. Avoid walking or driving on it. Do not cut it

unless it is very weedy in late June or early July, and then cut as high as possible. Most broad-leaved weeds can be controlled by spraying with a herbicide.

Seed production

Success in growing Russian wild ryegrass for seed can be strongly influenced by the following factors: seeding, fertilizing, irrigating, removing aftermath, harvesting, cleaning, and marketing.

Seeding. Establish seed production fields without using a nurse or companion crop, because such a crop reduces the seed yields of the grass for at least the first 2 years after seeding.

Highest yields have been obtained with row spacings of 60 cm (2 ft) or more (Table 6). At Swift Current the best yields were obtained when the grass was spaced in rows 90 to 120 cm (3 to 4 ft) apart. As it is difficult to cultivate between rows in 60-cm (2-ft) spacings, a 90-cm (3-ft) spacing is recommended for all locations (Fig. 11).

Fertilizing. Under average moisture conditions it pays to fertilize (Table 6).



Fig. 11. A field of Russian wild ryegrass sown for seed production in rows 90 cm (36 in.) apart.

TABLE 6. Average seed yields of Russian wild ryegrass on two dryland sites at various rates of 16-20-0 fertilizer and various row spacings.

Distance between rows, cm (in.)	Fertilizer kg/ha (lb/ac)	Swift Current 7 years	Lacombe 5 years
30 (12)	0	26 (23)	242 (216)
	150 (135)	66 (59)	286 (255)
	280 (250)	111 (99)	300 (268)
60 (24)	0	90 (80)	396 (353)
	150 (135)	155 (138)	467 (417)
	280 (250)	271 (242)	455 (406)
90 (36)	0	118 (105)	411 (367)
	150 (135)	185 (165)	411 (367)
	280 (250)	258 (230)	436 (389)
120 (48)	0	130 (116)	374 (334)
	150 (135)	233 (208)	402 (359)
	280 (250)	249 (222)	288 (257)

If fertilizer is applied annually at heavy rates, good yields of seed can be obtained continuously for many years from a single seeding. In a 7-year test at Swift Current the improvement in yield from addition of fertilizer increased as the stand aged (Table 7).

Russian wild ryegrass that received 16-20-0 fertilizer at 280 kg/ha (250 lb/ac) was able to maintain a reasonably good seed yield for the 7 years.

The time of fertilizer application is important. At Swift Current, seed yields were twice as great from an application in August as from an application at the same rate in spring. At Lacombe, Alta., the application of fertilizer in early fall gave a 16% higher seed yield than a similar one in the spring. Therefore, apply the fertilizer immediately after harvesting the seed crop.

The fertilizer required for good seed production depends on the soil. Growers should rely on results from soil testing for proper fertilizer recommendations.

Irrigating. In dry years some growers obtain good seed yields by using water from sloughs, dugouts, or other sources. Although the timing of irrigation has not been studied extensively, observations suggest that this water can be used most

TABLE 7. Average seed yields of Russian wild ryegrass sown in rows 90-cm (3-ft) apart and fertilized annually with 16-20-0, over a 7-year period, at Swift Current.

Fertilizer kg/ha (lb/ac)	Seed yields in kg/ha (lb/ac)						
	1st yr	2nd yr	3rd yr	4th yr	5th yr	6th yr	7th yr
0	65 (58)	188 (168)	216 (193)	149 (133)	91 (81)	81 (72)	36 (32)
150 (135)	85 (76)	187 (167)	244 (218)	241 (215)	161 (144)	314 (280)	58 (52)
280 (250)	90 (80)	285 (254)	318 (284)	315 (281)	249 (222)	409 (365)	142 (127)

efficiently by irrigating in August and again in early May. Where only one irrigation is possible, apply the water in early May. Information has been obtained on the 7-year average seed yields when two fertilizers were applied on irrigated plots at Pambrun, Sask. (Table 8).

TABLE 8. Seven-year average seed yields at Pambrun, Sask., irrigated and fertilized with 33.5-0-0 or 16-20-0 at various rates.

Fertilizer type	Fertilizer amount in kg/ha (lb/ac)	Seed yield in kg/ha (lb/ac) 7-yr mean
0	0	179 (160)
33.5-0-0	84 (75)	253 (226)
33.5-0-0	168 (150)	274 (244)
16-20-0	168 (150)	229 (204)
16-20-0	336 (300)	299 (267)

Aftermath. The leafy residue remaining after the seed has been harvested is nutritious and makes excellent feed for live-stock. Experiments at Swift Current showed that removal of the aftermath forage is essential to maintain high seed yields. When cattle or sheep grazed the aftermath there was an increase in seed yield the following year. The sooner grazing begins after harvest, the greater the increase in seed yield (Fig. 12). The grower who does not use the aftermath can expect lower seed yields and is wasting valuable pasture.

Harvesting. The seed of Russian wild ryegrass shatters readily and must be harvested before it is completely ripe. The best time to harvest is when the straw is golden yellow and the seed in the firm-dough stage.

The best method of harvesting is to swath the crop just above the leafy basal growth and then thrash with a combine several days later (Fig. 13). By this method the crop can be harvested at an earlier stage with much less loss in germination than when it is straight-combined. If the crop is straight-combined, good-quality seed can only be obtained in the 2 to 3 days before the seed shatters, and it must be dried artificially. Swathing as soon as possible and combining when the swath is dry allows harvesting to take place over a longer period, elimin-

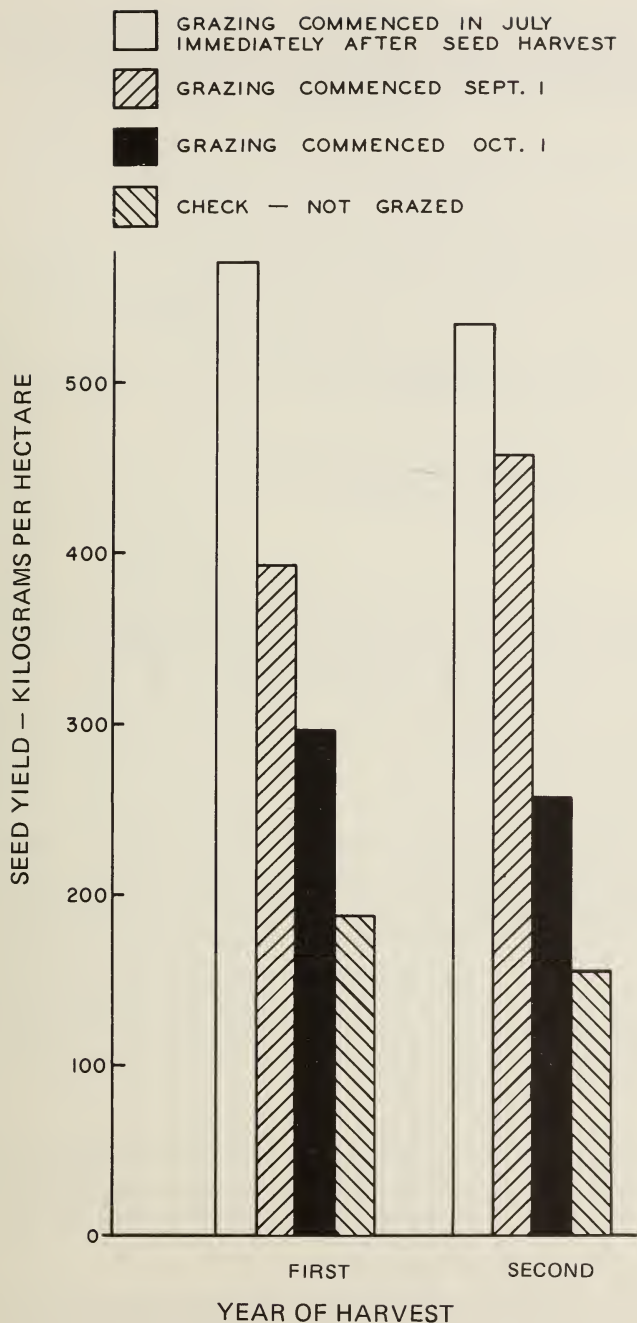


Fig. 12. Seed yields of Russian wild ryegrass as influenced by grazing after seed harvest during the preceding year (kg/ha \times 0.892 = lb/ac).

ates the need for artificial drying, and insures higher germination. However, cutting more than 6 days before maturity will result in low kernel weight and lower yield.

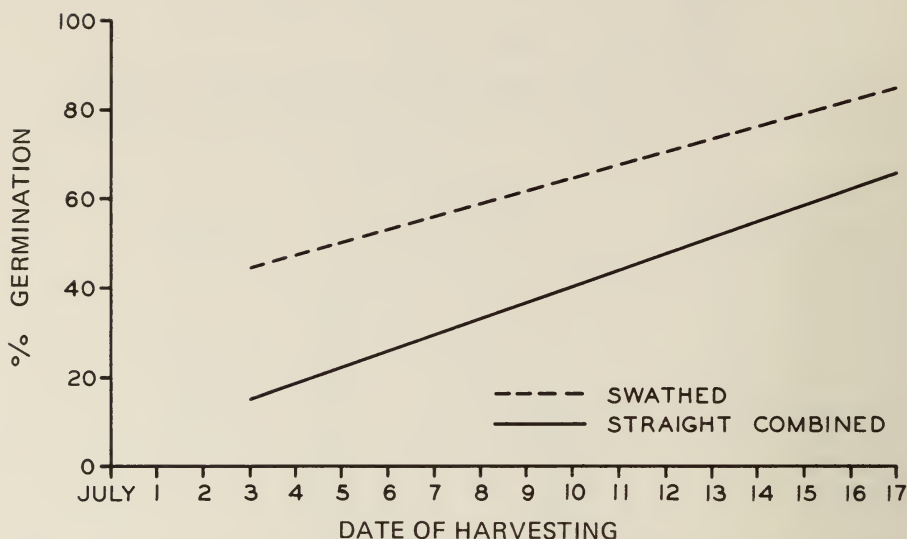


Fig. 13. Germination of Russian wild ryegrass seed when harvested by two methods on successive dates from July 3 to 17.

Although swathing and combining is a better method of harvesting than straight-combining, some difficulty has been experienced in picking up the swath when it falls between the rows. Some growers have solved this problem by seeding the field at an angle, and swathing it by going around the field so that all swaths cross the rows at an angle. Others arranged their fields by seeding two rows 30 cm (1 ft) apart where the swath would fall; with a self-propelled swather they could place the swath on the double rows.

Combines with rub-bar cylinders are more suitable for thrashing than the tooth cylinder types because they do not break up the straw as much. Correct combine adjustments come by trial and error and vary with the make of machine. The following suggestions may be helpful:

- At the start, adjust the cylinder to the same setting as for wheat. If much of the straw is broken so that it comes into the hopper with the seed, increase the clearance between the cylinder and the concaves. You may need to open up the cylinder as wide as possible. If this does not

give the desired effect, slow the cylinder down slightly. Be careful not to slow it too much because this reduces the capacity of the combine and it tends to become plugged when large wads come in.

- Set the adjustable sieves one-third to one-half open. You can find the best setting only by repeated trials.
- To clean the seed properly, slow down the fan as much as possible and adjust the wind-control doors. With some machines it may be necessary to insert pieces of cardboard to reduce the air intake.
- Direct the air blast toward the front of the sieves. This provides for better separation and seed is not blown over the back.
- You may have to slow down the operating speed of the pickup because at a high speed too much seed may be shattered or lost.

Cleaning. The ordinary fanning mill usually cleans the seed well enough to seed through a drill but does not remove all weed seeds. An indent disc with appropriate discs is necessary to remove them. If you try to remove all weed seeds with the fanning mill, much good grass seed may be lost.

Metal sheet screens are more suitable than wire screens for cleaning any grass seed. The wire screens plug up too easily and it is necessary to remove and clean them frequently.

Scalp the seed over a round-hole wheat or barley screen before cleaning. The scalping removes parts of heads and about 90% of the broken straw. A 5.9- or 6.4-mm (15/64- or 16/64-in.) round-hole screen is satisfactory.

For cleaning, a slotted screen 6.4×6.4 mm ($\frac{1}{4} \times \frac{1}{4}$ in.) on top and 1.2 mm ($\frac{1}{20}$ in.) round-hole at the bottom is usually satisfactory. Depending on the quality of the seed, it may be necessary to use screens larger or smaller than these.

If cleaning equipment is not available on the farm, the seed can be cleaned at a commercial seed cleaning plant. It is best to make the arrangements long before harvest.

Marketing. Most of the seed is sold to commercial seed houses. The seed is in demand for Canadian use and export, and most seed companies handle it. If you grow a large quantity of seed, it is advisable to invest in cleaning machinery and to clean the seed yourself. If you have a small quantity, it may be marketed through commercial seed houses in uncleaned form.

There is a charge for cleaning the seed, and the dockage increases the cost of shipping.

Seed in 25-kg (55-lb) sacks is the easiest to handle; larger sacks are awkward. Also, many sales are made in multiples of 25 kg.

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